USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Eastern Region State and Private Forestry | April 2021

Eastern Region Forest Health Conditions Report 2020

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Cover Photo : White pine needle damage. Photo credit: Isabel Munck, USDA Forest Service

2020 Surveys

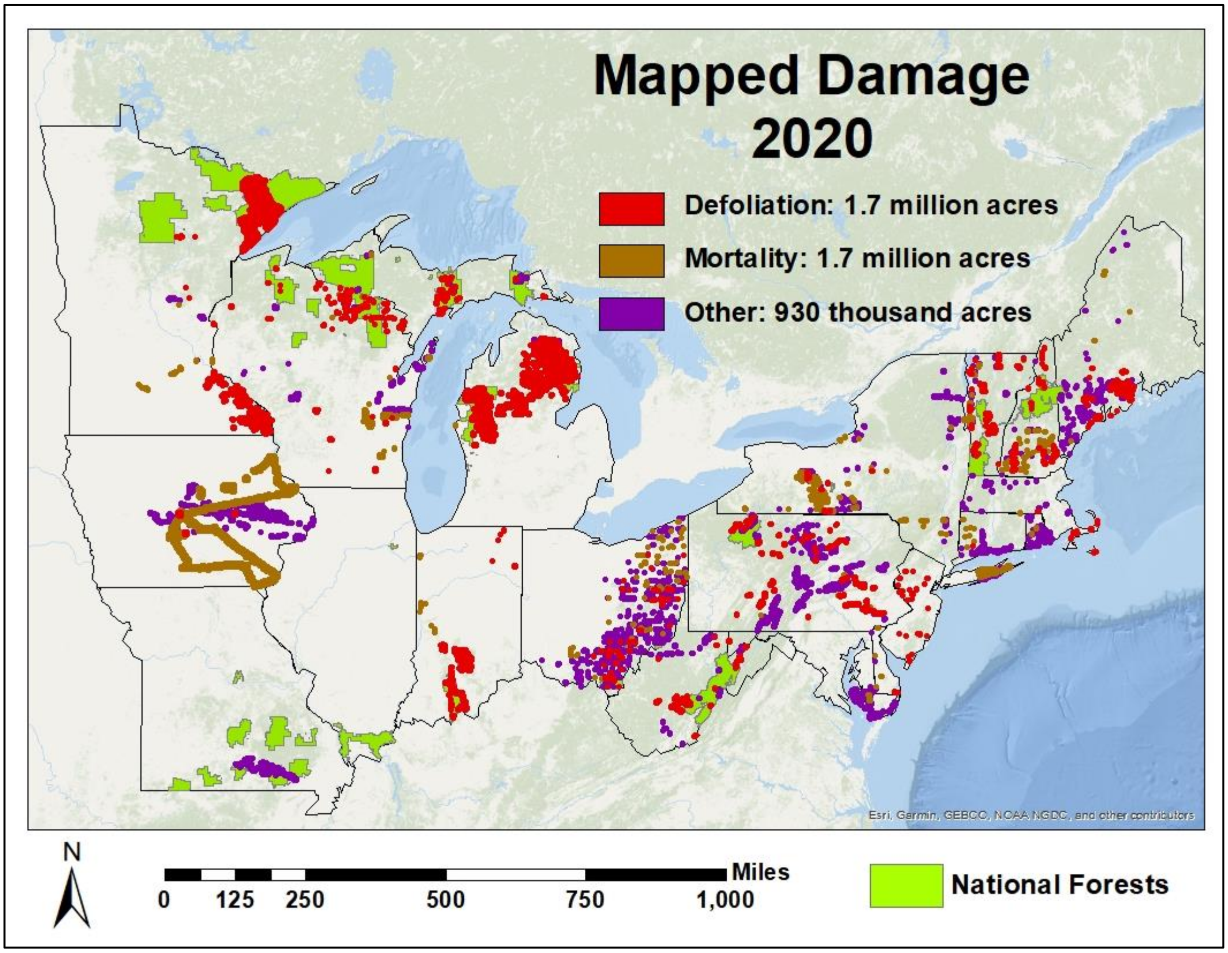

Figure 1. Map of Eastern Region with damage mapped through aerial detection, remote sensing, and ground surveys during 2020. Additional pest and disease information below.

This report includes 2020 forest health data and information for the Eastern Region (Region 9) of the USDA Forest Service. Data and information were compiled from Aerial Detection Surveys (ADS), Pest Event Reporter (PER), ForHealth, and State Forest Health Highlights (FHH). Surveys included aerial surveys, remote sensing, and ground assessments. This report focuses on forest health issues having, or the potential to have, large scale impacts across the Region. This is not a complete list of insects, diseases, and abiotic factors affecting Eastern Region forests. For additional damage agents please see the table on page 24 and read state FHH.

Restrictions in 2020 due to COVID-19 limited abilities to assess forest health across the Region. In total, over 100 million acres were surveyed. This is 41% of area surveyed in 2019 and 38% of the average number of acres assessed in the previous 5 years. Despite a reduction in acres surveyed, recorded damage increased from 3.8 million acres in 2019 to 4.4 million acres in 2020. A rise in observed damage was largely due to increases in gypsy moth and emerald ash borer. Gypsy moth increased from 456,000 acres to 980,000 acres in 2019 and 2020,

respectively, and emerald ash borer recorded damage increased from 1.2 million acres in 2019 to 1.9 million acres in 2020 (further details below).

For additional state and survey information follow the links below.
[Eastern Region Aerial Detection Survey Dashboard]
[Region 9 2020 State FHH]

2020 Treatments

In total, 246,000 acres were treated in Region 9 through Forest Health Protection (FHP) funding. This does not include all treatments conducted in the Region, only treatments at least partially funded by the FHP program. Most treatments (96%) occurred on cooperator lands with a total of 237,000 acres reported. On federal lands, 9,400 acres were treated. Gypsy moth Slow the Spread comprised a majority of conducted treatments last year (98%). Additional insect and disease treatments were for emerald ash borer, hemlock woolly adelgid, invasive plants, oak wilt, and southern pine beetle (Table 1).

Table 1. Treatments funded by Forest Health Protection in 2020, Columns show damage agent treated, the state were treatments took place, land ownership where treatments occurred, acres treated, and general treatment administered.

Damage Agent and State	Federal, State, or Tribal Lands	Acres Treated	Treatment
Emerald Ash Borer			
VT	State	80	Chemical - Soil/Tree injection
Gypsy Moth (Slow the Spread)			
IL	State	19,305	Mating disruption and Btk[1]
IN	State	5,165	Mating disruption and Btk[1]
MN	State	1,600	Btk[1]
OH	State	65,694	Mating disruption, Btk[1], and NPV[2]
OH	Federal	4,841	Mating disruption and NPV[2]
WI	State	142,166	Mating disruption and Btk[1]
WI	Federal and Tribal	4,129	Mating disruption and Btk[1]
Gypsy Moth (Not Slow the Spread)			
MD	State	300	Btk[1]
HWA Suppression			
MD	State	400	Chemical - Soil/Tree injection
NY	Federal	93	Chemical - Soil/Tree injection
NY	State	125	Chemical - Soil/Tree injection
OH	State	500	Chemical - Soil/Tree injection
PA	State	650	Chemical - Soil/Tree injection

WV	Federal	260	Chemical - Soil/Tree injection
Invasive Plants			
PA	State	400	Multiple spp. - Chemical
NY	State	74	Kudzu - Chemical
Oak Wilt			
MI	State	120	Trenching
MI	Federal	10	Trenching
MN	State	50	Trenching
NY	State	5	Trenching
VT	State	550	Chemical
WI	Federal and Tribal	67	Trenching, Cut and Remove, and Chemical
Southern Pine Beetle			
NY	State	200	Cut and leave

[1] *Bacillus thuringiensis var. kurstaki*

[2] *Gypsy moth nucleopolyhedrosis virus*

Insects

Asian longhorned beetle (*Anoplophora glabripennis*)

Asian longhorned beetle (ALB), is an invasive woodboring insect which attacks multiple genera of hardwood trees (Figure 2). Preferred hosts for ALB are *Acer* (maple), *Populus* (aspen, poplar, and cottonwood), and *Salix* (willow), but many other genera are also attacked. Since its first discovery in the United States in 1996, infestations have been identified in six states (Illinois, Massachusetts, New Jersey, New York, Ohio, and South Carolina). Eradication efforts are implemented immediately following discovery to prevent spread. Unchecked, ALB induced tree mortality has the potential to alter urban and forest ecosystems. Early detection followed by eradication is the best defense to prevent ALB from spreading following initial introductions.

Figure 2. Asian longhorned beetle adult and exit hole. Photo credit: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org.

Asian longhorned beetle eradication efforts continue in Ohio. A 57 square mile ALB quarantine, centering on Tate Township in Clermont County, has been managed by both USDA Animal and Plant Health Inspection Service (APHIS) and Ohio Department of Agriculture. As of November 2020, over 21,000 infested trees have been identified from 3.4 million surveyed, and over 20,000 trees have been removed. As part of a tree replanting program, initiated by Ohio

Division of Forestry, 1,600 ALB non-host trees have been distributed to impacted landowners for planting.

Surveys for ALB continue in other states. A single ALB adult was collected in Porter County, Indiana. Trapping and surveys in the area did not result in additional finds, indicating this may be an interception rather than an infestation. Indiana will continue surveys in 2021. In Massachusetts, a single infested maple tree was identified and removed in Auburn in Worcester County; no other ALB were detected. In New York, the ALB eradication program has been ongoing for over 20 years. Infested trees have been removed and destroyed. As of now, ALB has been eradicated from all boroughs of New York City, with only the quarantine in central Long Island still active.

Eastern spruce budworm (*Choristoneura fumiferana*)

Figure 3. Spruce budworm larvae. Photo credit: Neil Thompson, University of Maine at Fort Kent, Bugwood.org.

Spruce budworm (SBW) is one of the most destructive native insects in the northern spruce and fir forests in the Eastern United States (Figure 3). Periodic SBW outbreaks occur throughout its range. Caterpillars preferentially feed on balsam fir and to a lesser degree white spruce. Feeding on black spruce, tamarack, hemlock, and pine occurs, but they are not preferred hosts. Spruce budworms feed primarily on current year needles but will “back feed” on older needles when populations are at higher levels and new growth has been consumed. Damage primarily occurs in upper crowns but can affect entire trees. Heavy feeding for consecutive years can result in complete defoliation, top-kill, and mortality. Tree mortality due to spruce budworm defoliation has the potential to alter stand composition.

In 2020, 374,000 acres of SBW damage was recorded (Figure 4). A majority of the damage was mapped in Minnesota in Superior National Forest. Ground and aerial surveys were used to record roughly 356,000 acres of SBW damage in Minnesota, but State forest health staff indicate this is likely overestimated. In Michigan 14,000 acres of SBW damage were recorded, indicating a second year of increasing defoliation from SBW in the Upper Peninsula. Defoliation in Michigan was greatest in central to western Upper Peninsula, including Delta, Marquette, and Menominee Counties. Wisconsin saw an increase of defoliation from the previous year. Consecutive years of SBW defoliation in northern Wisconsin is leading to decline, and over 400 acres of mortality due to SBW was recorded in 2020.

Not shown on the map is the SBW outbreak currently occurring in eastern Canada, predominately in Quebec. New England states are tracking the outbreak, monitoring for defoliation, and conducting adult trapping to determine if the SBW outbreak has entered the United States. Pheromone trapping, light trapping, overwintering larval sampling, and ground and aerial surveys conducted in Maine indicate an upward trend in SBW populations. Presence of mature SBW larvae across northern Maine and visible signs of defoliation in multiple locations, marks the first time SBW larvae have been so easily found since the late 1980s. Trapping in New Hampshire indicates SBW populations remain at endemic levels. Trap catches declined in Vermont, with an average of 0.44 moths/trap collected in 2020 compared to 4.2 moths/trap in 2019. Despite the increase in Maine trap captures and increasing defoliation, the northern outbreak has not yet crossed the border into the United States. Monitoring efforts will continue in 2021.

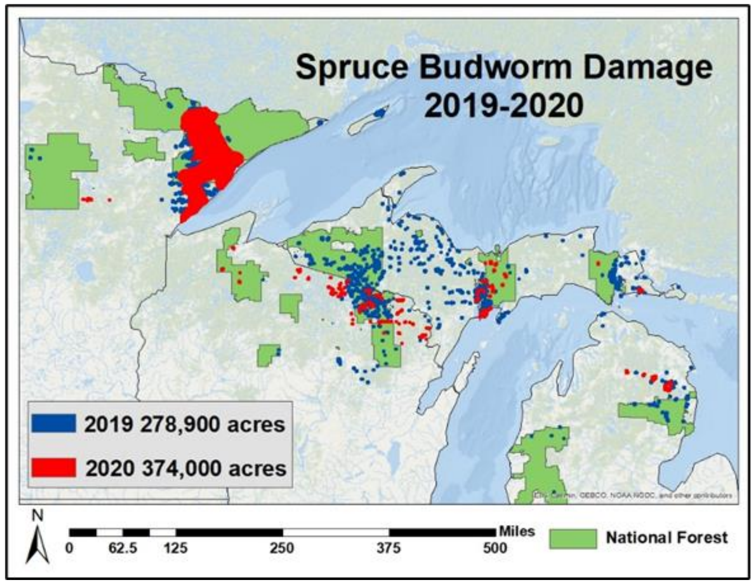

Figure 4. Spruce budworm mapped damage 2019 and 2020.

Additional information
[Maine SBW Task Force]

Emerald ash borer (*Agrilus planipennis*)

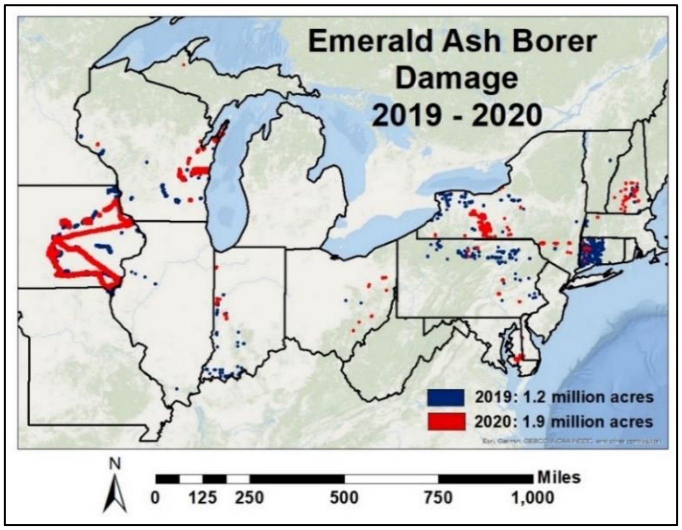

Figure 5. Mapped EAB damage for 2019 and 2020 in Region 9.

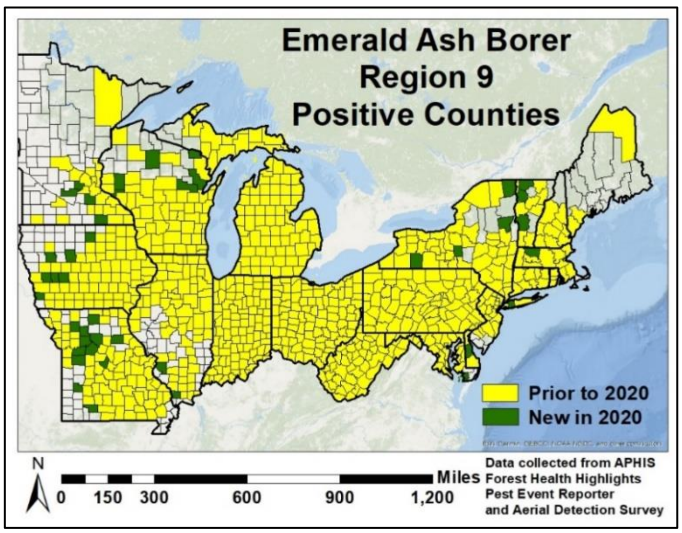

Figure 7. Map of Region 9 EAB positive counties.

Figure 6. Emerald Ash borer adult. Photo credit: Debbie Miller, USDA Forest Service, Bugwood.org.

Emerald ash borer (EAB), is an invasive insect discovered in southeastern Michigan in 2002 (Figure 6). It has since spread to 35 states and five provinces of Canada. In the Forest Service's Eastern Region, EAB is present in all 20 States and D.C. Disruption of water and nutrient transportation by larval feeding within host trees leads to branch dieback and eventual mortality. Since its introduction, it has killed hundreds of millions of ash trees essentially removing or severely reducing ash in impacted stands.

In 2020, 1.9 million acres of EAB caused mortality was mapped in the Eastern Region (Figure 5). A majority of damage was recorded in Iowa, but additional state surveys (not mapped here) reported considerable further damage across the region. Examples include Connecticut reporting high levels of mortality in the western two-thirds of the State, in D.C. in the National Capital Area standing dead ash now outnumber live ash trees, and in New Hampshire infested areas have increased to impact over half the State. In 2020, new positive counties for EAB were recorded in Delaware, Illinois, Iowa, Maryland, Massachusetts, Minnesota, Missouri, New York, Wisconsin, and Vermont, and several states have recorded EAB in all counties (Figure 7).

Additional information
[EAB Information Network]
[EAB University]

European gypsy moth (*Lymantria dispar dispar*)

Figure 8. Gypsy moth larva. Photo credit: Steven Katovich, USDA Forest Service

Introduced from Europe to Medford, Massachusetts in 1869, gypsy moth has spread substantially over the last 150 years (Figure 8). Quarantines are currently in 18 states in Region 9 (Figure 9). Only Iowa and Missouri do not yet contain quarantined counties. Gypsy moth Slow the Spread (STS) program works to reduce the moth's rate of expansion. No new Region 9 counties were added to the gypsy moth quarantine in 2020.

To learn more about Gypsy Moth visit the following links

[Gypsy Moth Digest]

[Forest Service Gypsy Moth Site]

Gypsy moths are capable of feeding on hundreds of tree and shrub species. Typically preferred North American hosts include oaks, aspen, apple, willow, basswood, hawthorns, and some birches and alders. Healthy trees can often withstand severe gypsy moth defoliation for a few years, but tree mortality can occur when consecutive years of defoliation overlap with additional stressors such as other insect and pathogen damage and/or abiotic factors.

In 2019, gypsy moth caused tree mortality was recorded in Connecticut, Massachusetts, Rhode Island, and parts of southern New Hampshire (Figure 10). Mortality was likely due to high levels of consecutive years of gypsy moth defoliation co-occurring with drought. In 2020 populations of gypsy moth were low in areas of previous mortality with only 140 acres of defoliation recorded in Massachusetts and low egg mass counts in both Connecticut and Rhode Island.

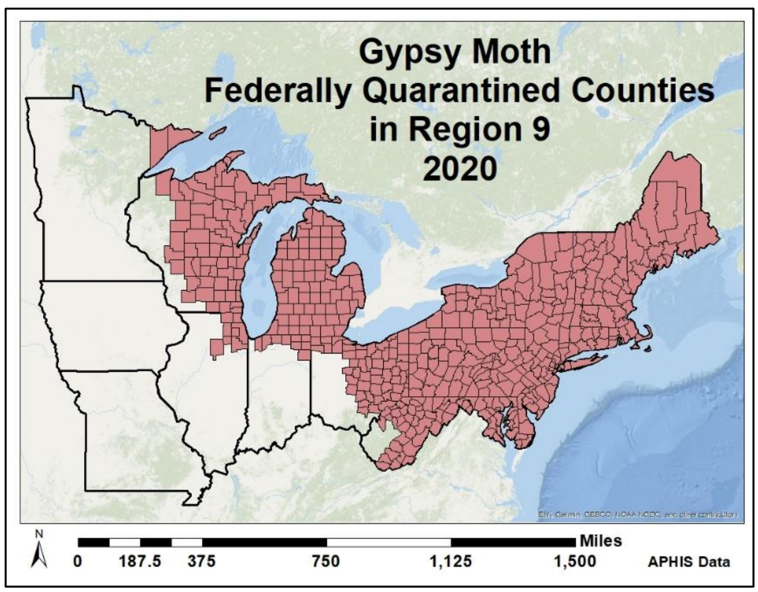

Figure 9. Federal gypsy moth quarantine counties in Region 9 States as of 2020.

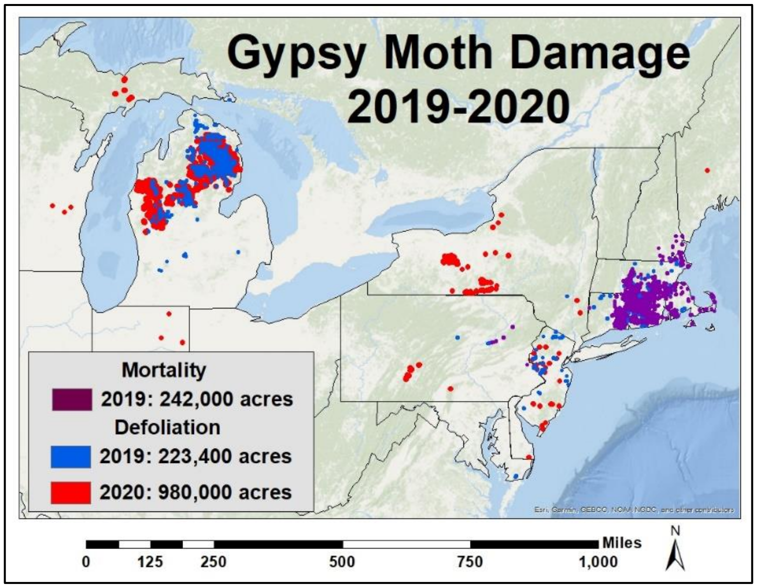

Figure 10. Gypsy moth mapped damage in 2019 and 2020.

While gypsy moth populations declined in New England in 2020, they rose in other parts of the Region. Heavy defoliation in Michigan's northern Lower Peninsula increased from roughly 200,000 acres in 2019 to 950,000 acres in 2020 (Figure 10), comprising nearly 97% of all gypsy moth damage mapped last year. Additionally, moderate to severe defoliation occurred in New York with most damage recorded in the western Finger Lakes (roughly 45,000 acres based on NY's FHH). Lastly, following two years of low gypsy moth population levels in Wisconsin, Slow the Spread trap captures increased by > 60% in western counties compared to the previous year. Indicating potentially rising populations in the State.

Additional information
[Updated Gypsy Moth Forest Insect and Disease Leaflet (FIDL) (2020)]

Hemlock Woolly Adelgid (*Adelges tsugae*)

Following initial reports in Virginia in 1951, the invasive hemlock woolly adelgid (HWA) (Figure 11) has spread widely and has become the most critical pest of hemlocks in Eastern North America. It has had severe impacts, including reduced growth and mortality, on eastern and Carolina hemlock. Hemlock decline and mortality can occur within 4 to 10 years in its northern range or 3 to 6 years in more southern locations. Treatments include silvicultural, chemical, and release of biological control agents.

Figure 11. Hemlock woolly adelgid on a hemlock branch. Photo Credit: Steven Katovich, USDA Forest Service Bugwood.org.

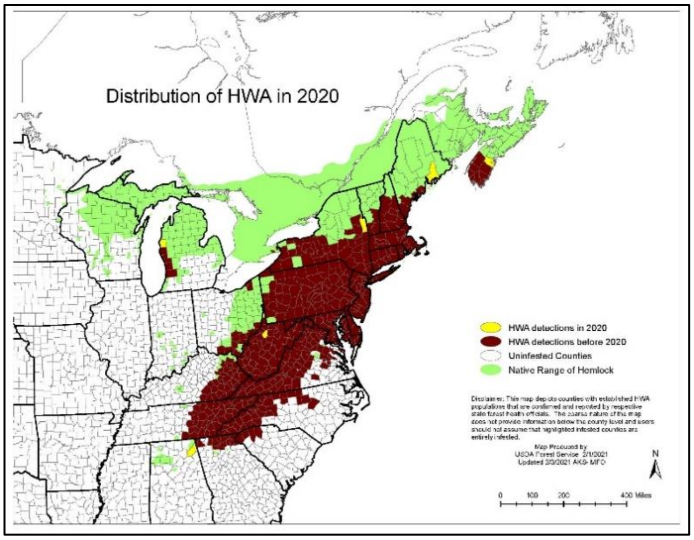

Figure 12. Map showing the range of eastern hemlock and HWA. New 2020 HWA infestations shown in yellow.

Limited damage was mapped in 2020 using ADS data (108 acres between NY and PA), but surveys by states recorded increasing damage due to HWA across the insect's range. In 2020, Maine's HWA state quarantine was expanded for the first time since 2013 to encompass areas further inland and eastward along the coast. Shortly following the expansion, HWA was detected in Hancock County, within the new quarantine range. This marks the first record for HWA in this county (Figure 12). In Massachusetts, HWA population densities increased across the State due to mild winter conditions. Mortality of hemlock in Massachusetts was highest in stands where HWA co-occurred with elongate hemlock scale (*Fiorinia externa*) (EHS) (Figure 13). Hemlock decline is accelerated where HWA and EHS co-occur. Nearly all hemlock (roughly 25,000 acres) in New Jersey have some level of HWA infestation. Eastern hemlock is a priority forest resource in NJ and the New Jersey Forest Service (NJFS) collected hemlock cones to bank and propagate native hemlock seeds. New York reported a large increase in adelgid counts throughout the state, and the HWA infestation in Michigan ranges roughly 100 miles along Lake Michigan's shoreline with an expansion of its range north into Mason County in 2020 (Figure 12).

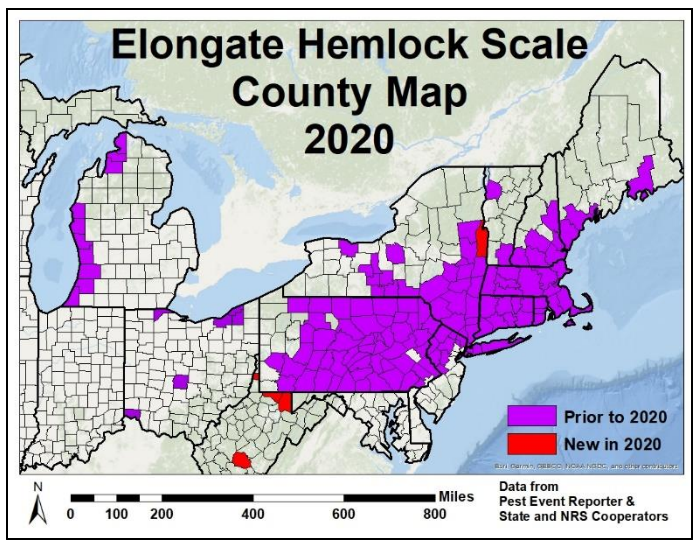

Figure 13. Positive counties for reported elongate hemlock scale.

Additional information for HWA
[Hemlock Woolly Adelgid]

Oak shothole leafminer (*Japanagromyza viridula*)

Oak shothole leafminer (OSL) is a native fly feeding on oak across much of Region 9. First described in 1967 little is known about this insect. Historically, damage has been light and scattered, but for the last several years populations have risen in several states impacting large areas. Factors contributing to these outbreaks have yet to be determined, and what impacts consecutive years of heavy OSL oak defoliation will have remains unknown.

Figure 14. Oak shothole leafminer adult feeding damage. Photo credit: Jim Altemus PA DCNR.

Much of OSL biology still requires further investigation. It is known that females feed by puncturing leaf buds with their ovipositor and consuming the exuded fluid produced from the wound. As the leaf unfolds, a characteristic pattern emerges with wounds on one side of the leaf typically mirrored by wounds across the leaf's midrib on the opposite side (Figure 14). Eggs are oviposited on leaves and larvae feed in blotch mines between outer leaf layers. Oak in both the red and white oak groups are attacked.

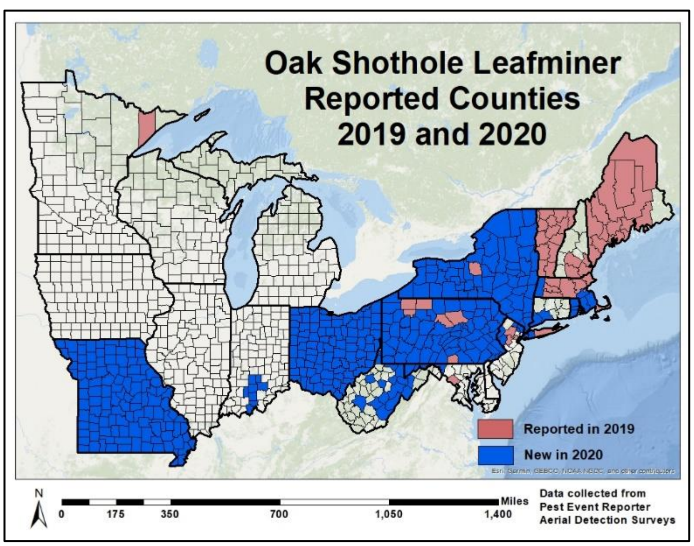

Figure 15. Map of reported counties for oak shothole leafminer in 2019 and 2020. All 2019 counties were also positive in 2020.

Several states reported OSL defoliation in 2020 (Figure 15). Overlapping damage from OSL, anthracnose, and frost was mapped on nearly 77,000 acres in southcentral Indiana. Additional OSL damage in Indiana was observed by foresters measuring forest inventory plots. In New Hampshire, over 1,600 acres of damage were recorded in the southern portion of the State. Growing populations of OSL over the last several years has led to damage recorded across most of Ohio in 2020. In New Jersey, surveys were limited due to COVID-19 restrictions, but with assistance from the public. OSL damage was reported in seven of the State's 21 counties. New Jersey state forest health staff say this is not a comprehensive list of impacted counties. Monitoring efforts will continue to track these outbreaks in 2021.

Spotted lanternfly (*Lycorma delicatula*)

Figure 16. Spotted lanternfly adult. Photo Credit: Lawrence Barringer, PA Dept of Ag., Bugwood.org.

First specimens of spotted lanternfly (SLF) in the United States were collected in Berks County, Pennsylvania in 2014. Signs and symptoms aside from the presence of the insect (Figure 16) are gray egg masses which can be found on or around host trees, dark streaks of flowing sap on trees from SLF piercing bark to feed on phloem and sap, and honeydew (liquid insect waste) at bases of host trees that can become covered in sooty mold. Tree-of-heaven appears to be a preferred host, but SLF has a wide host range. As of now, it is unknown what impacts, if any, this invasive insect may have on forested ecosystems, but the Forest Service will continue monitoring this pest.

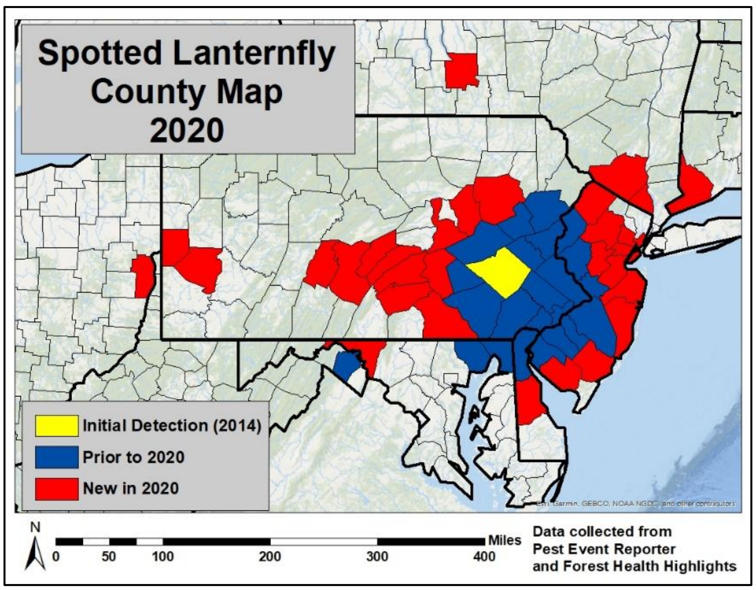

Figure 17. Counties positive for spotted lanternfly infestation by year. Does not include individual captures of various SLF life stages.

Established spotted lanternfly populations in new counties were recorded in 7 states in 2020 (Figure 17). In Pennsylvania, 13 new counties were recorded in an apparent march west for the insect. In Delaware, SLF is becoming established in northern and central portions of the State, and populations have been found in nearly every county of New Jersey. Spotted lanternfly was found in lower Fairfield County in Connecticut, marking the first established population in New England. An infestation of spotted lanternfly in Jefferson County, Ohio was discovered along the Ohio River in the eastern portion of the State. The Jefferson County infestation was found near a railyard, with trains regularly traveling from the East Coast. The first infestations in New York State were reported on Staten Island, Port Jervis, Sloatsburg, Orangeburg, and Ithaca.

Spotted lanternfly egg masses, and adult insects, both dead and alive, have been found in additional locations. In Vermont, a nursery from an infested state shipped trees containing spotted lanternfly egg masses on their upper branches. Before shipping stock out, the nursery removed egg masses from the tree trunks but not the upper limbs. These trees were shipped to states across New England. In Maine, SLF egg masses were found on imported red maple

nursery stock. Trees from this shipment were planted in the towns in several towns across multiple counties. It is believed nymphs had emerged from egg masses prior to their arrival in Maine, but the state will monitor these areas in 2021. In Michigan, dead SLF adults were found on nursery stock shipped from an infested state, and in a shipment of building supplies in southeast Michigan. Further investigations by state and federal agencies found no other evidence of spotted lanternfly in the State.

Southern pine beetle (*Dendroctonus frontalis*)

Southern pine beetle (SPB) is an aggressive tree-killing bark beetle (Figure 18). Pine trees are primary hosts, but other members of the pine family (Pinaceae) such as spruce and hemlock may be attacked during outbreaks. Historically, SPB have been restricted to the Southeast and Southwest United States, Mexico, and Central America. In recent decades, warmer temperatures have permitted SPB to move north infesting pine in Mid-Atlantic states, New York, and New England. Concerns of SPB infesting northern stands are matched by concerns over changing climates allowing a southern species to move north. Southern pine beetle's northern advance may be an indicator of additional climate driven changes on the horizon.

Figure 18. Southern pine beetle adult. Photo credit: Erich G. Vallery, USDA Forest Service - SRS-4552, Bugwood.org.

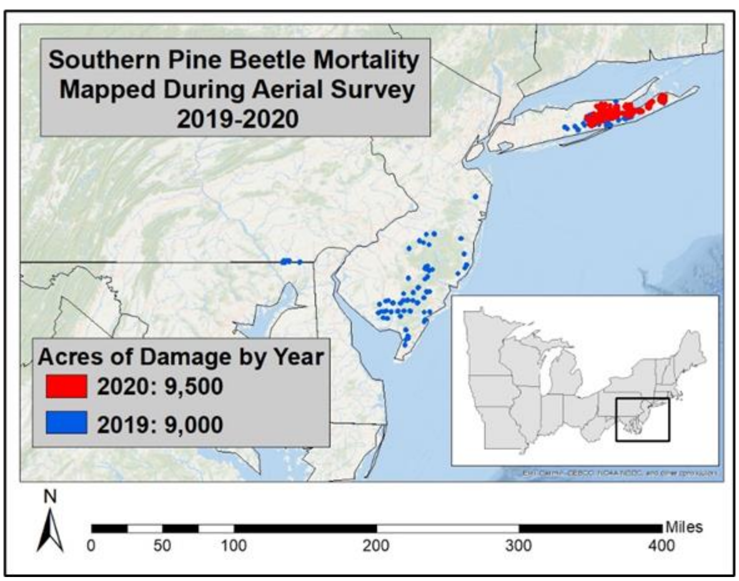

Figure 19. Mapped southern pine beetle damage in 2019 and 2020.

In 2020, 9,500 acres of SPB damage were mapped during aerial survey (Figure 19). Multiple states reported additional southern pine beetle activity. It has been detected attacking multiple pine species and Norway spruce, in New Haven, Litchfield, and New London Counties in Connecticut. Trapping has identified a small SPB population in Rhode Island, but an outbreak has not yet been observed. In New Jersey, 1400 acres of mortality were recorded in 2020 (not mapped here), this is a reduction of over 200 acres from the previous year. Trap captures indicate low populations in Delaware and Maryland.

On Long Island in New York, SPB outbreaks continue near the towns of South Hampton and East Hampton. Suppression efforts have reduced SPB populations below outbreak levels within the

Core of the Central Pine Barrens. Early in the year New York Department of Environmental Conservation (DEC) thinned and mechanically treated 47.5 acres in Sarnoff State Forest. In the fall, 556 trees were cut during State suppression efforts, bringing the total number of trees cut to 21,917 since 2014. Further north, SPB monitoring recorded low trap captures in the Lower Hudson Valley at Bear Mountain, Schunnemunk, and Minnewaska State Parks.

Diseases

Beech leaf disease

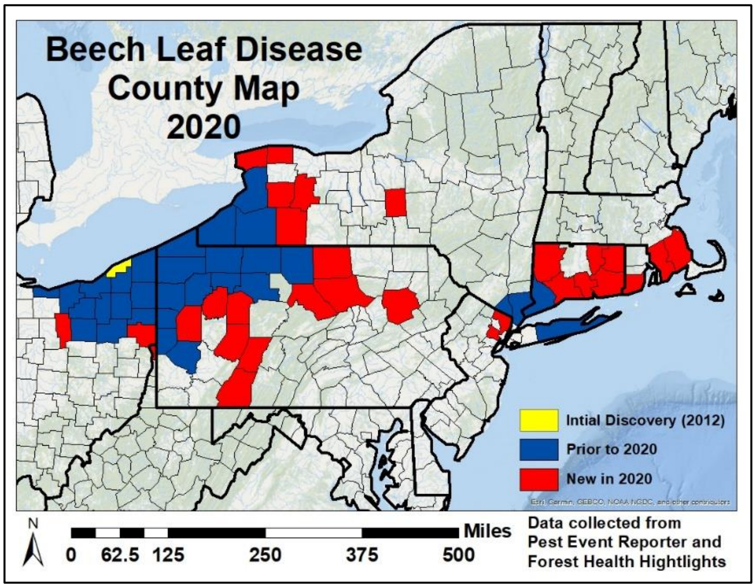

Figure 20. Positive beech leaf disease counties and states as of 2020.

First discovered in Lake County in northeast Ohio in 2012, beech leaf disease (BLD) has been found in Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, and West Virginia (Figure 20). The foliar nematode *Litylenchus crenatae* ssp. *maccannii* is associated with BLD and a likely causal agent. Initial symptoms of BLD include dark bands between lateral leaf veins (Figure 21). Bands are apparent at budbreak. Additional symptoms include aborted bud development, leaf curling, necrosis, premature leaf drop, branch dieback, and occasional beech mortality. Mortality is more common in smaller trees. Further research on potential long-term effects of BLD on the beech resource and forest stands is necessary to determine what impacts this invasive pathogen will have on forested ecosystems.

Figure 21. Leaf banding showing infection by beech leaf disease.

Beech leaf disease is being monitored in numerous states. Seven of eight Connecticut counties have confirmed BLD. Infected areas are widely scattered, but substantial damage is evident in these locations. In Massachusetts, BLD was detected in both Plymouth and Bristol Counties in 2020. This marks the first detection of BLD in Massachusetts. New York detected BLD in six new counties last year, and it is now confirmed in western, central, and southeastern

portions of the State. Ten new Pennsylvania counties were marked positive for BLD in 2020, bringing the total number of positive counties in the State to 22. In Rhode Island, BLD was identified on a declining beech in Washington County. A survey of the area found additional infested trees. In Ohio, where the initial BLD infestations were discovered, two new eastern counties were found to have infested beech in 2020.

Beech leaf disease may be more widely distributed than records indicate. A more precise delineation of BLD's range is ongoing. Multiple discoveries of substantial populations across large areas in a single year, indicate this is more likely detections of pre-existing established populations rather than a spread of the disease into new areas in a 12-month span. States known to have BLD and surrounding states will continue to monitor for the disease.

Bur oak blight (*Tubakia iowensis*)

Figure 22. Bur oak blight infected tree. Photo credit: Steven Katovich, USDA Forest Service, Bugwood.org.

Bur oak blight (BOB) is a native leaf blight impacting bur oak and occasionally swamp white oak in Midwestern States. (Figure 22). Increases in disease severity are believed to be due to wetter springs, producing optimal conditions for fungal growth. Bur oak blight is most prevalent on the upland variety of bur oak, *Quercus macrocarpa var. oliviformis*. Susceptibility of bur oaks to BOB is highly variable, with healthy bur oak growing next to heavily impacted trees. Repeated BOB defoliation can increase bur oak susceptibility to secondary insects and pathogens leading to tree decline and death.

Leaf symptoms typically appear in late July or August. Numerous small circular purple-brown lesions develop on the underside of leaves along midveins and major lateral veins. As the disease progresses lesions increase in size and dark veins become apparent on leaf upper surfaces. Large areas of chlorosis and necrosis develop on leaf blades, and diseased areas may coalesce, causing large areas of the leaf to die. Wilting and scorched effects caused by BOB can resemble symptoms of oak wilt.

States report varying impacts of BOB on bur oak trees. In Iowa, most counties are positive for BOB (Figure 23) and the disease is causing severe decline and mortality. Following several consecutive wet years, Wisconsin reports an apparent increase in severity of the disease, and three new counties were reported positive in the southeast portion of the State. Minimal impacts have been reported in Indiana where the disease has only been found in two counties. Based on communication with Phil Marshal (Forest Health Specialist IN DNR Division of Forestry) *Quercus macrocarpa var. oliviformis* is not as prevalent in Indiana as other bur oak varieties which may explain the limited distribution of BOB in the State. In Minnesota, bur oak blight does not seem as severe. Levels of BOB in Minnesota remained at similar levels from 2019 to 2020, and infected trees generally recover.

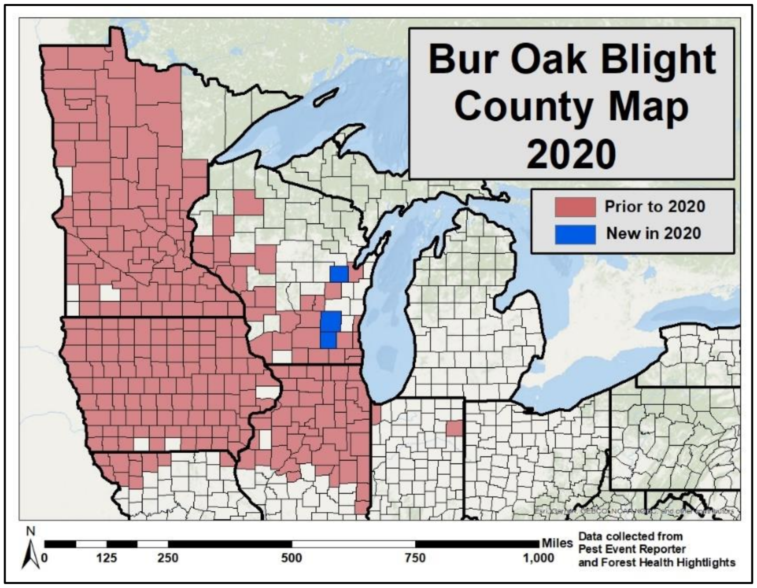

Figure 23. Bur oak blight positive counties in Region 9.

Oak wilt (*Bretziella fagacearum*)

Oak wilt is a fungal pathogen impacting oak trees across much of Region 9 (Figure 24). First described in the 1940s, millions of oaks have been killed by this pathogen across much of the Eastern United States. All oak species are at least partially susceptible to the pathogen; oaks in the red oak group are more vulnerable compared to white oak. White oak is capable of compartmentalizing infections, restricting its spread within the tree, but can still be killed by the pathogen. The disease spreads from tree to tree through root grafts and transmission by sap beetles (Coleoptera: Nitidulidae). Stands with oak wilt should be treated to restrict the spread of this disease.

For additional information on oak wilt treatment guidelines follow the link below.
[Revised 2020 Oak Wilt Suppression Program Participation Guidelines]

Figure 24. Oak wilt infected tree. Photo credit: Steven Katovich, USDA Forest Service, Bugwood.org.

Oak wilt was reported in several Region 9 states in 2020, but only one new positive county was reported for the region (Grundy County, Missouri) (Figure 25). In Iowa, new areas of oak wilt were mapped following survey flights intended to map damage due to a derecho that hit the

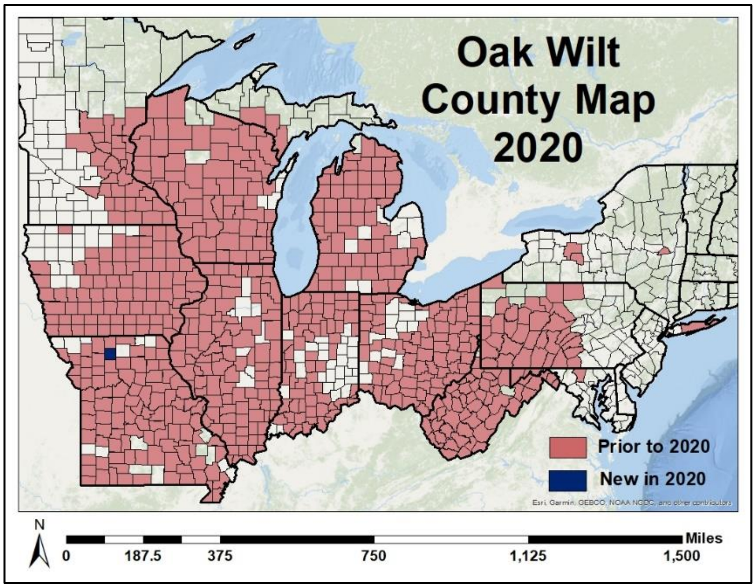

Figure 25. Oak wilt positive counties for Region 9 in 2020.

State in early August. Iowa plots will be monitored in 2021. In Minnesota, the disease has spread through roughly 50% of the State's red oak range, and is common in central, east central, and southeast portions of the State. New York continues to maintain six active quarantine districts, and aerial and ground surveys in the State did not locate new infections outside these areas. In other states, oak wilt was reconfirmed in five counties in east central and southcentral portions of Indiana, recent increases in oak wilt infections in the northcentral portion of Pennsylvania were reported, in Ohio new and existing infections were reported in seven eastern counties, and Wisconsin confirmed oak wilt for the first time in northern communities in Oneida and Douglas Counties. Additional States in the Region continue to monitor and treat for oak wilt.

Sudden oak death (*Phytophthora ramorum*)

Sudden oak death (SOD) is a potentially devastating disease found primarily in California, Oregon, Washington, and British Columbia. Over the last 20 years, infected nursery stock has been occasionally shipped to nurseries and retail stores in the Eastern United States. In the West, the disease kills some oak species, primarily coast live oak and tanoak (a relative of oak) and causes ramorum leaf blight on rhododendrons, camellias, and other common horticultural plants. In 2019, *P. ramorum* was detected on plants in retail stores in IL, IN, MO, OH, IA, MD, MI, PA, and WI. In NE and MI, APHIS confirmed some *P. ramorum* positive plants were outplanted on the landscape after being purchased from stores known to have received infected stock. These plants were likely infected prior to planting. Plants were removed and no other infected plants have been detected in Region 9 States. Stream sampling for *P. ramorum* in Region 9 is ongoing. In 2020, the following states submitted samples for sudden oak death stream baiting surveys: IL, MD, OH, PA, WI, and WV. All stream baiting test results were negative for *P. ramorum*.

Thousand cankers disease

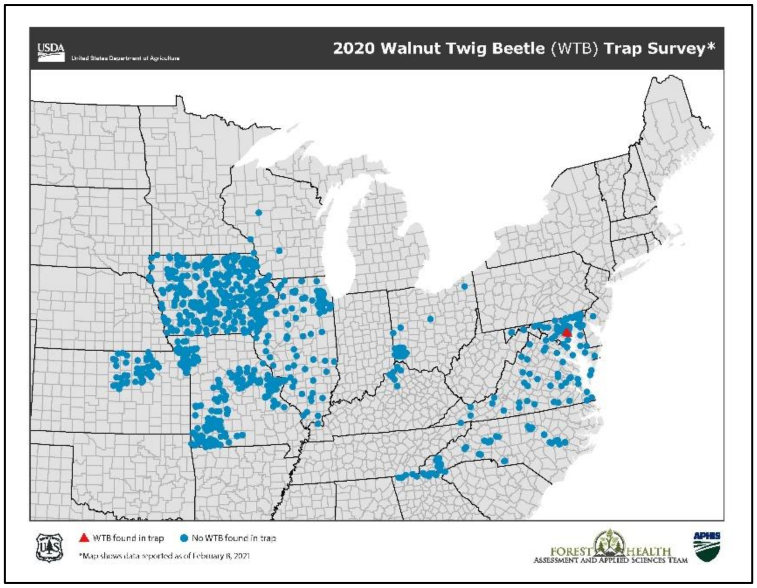

Figure 26. 2020 Walnut twig beetle trapping locations and results.

Thousand cankers disease (TCD) is transmitted by the walnut twig beetle (WTB) (*Pityophthorus juglandis*) and caused by the fungus *Geosmithia morbida*. Originally described in western states, it was discovered in Knoxville, Tennessee in 2010. This was the first report east of the Great Plains. Following the initial discovery, TCD has been found in seven eastern states (TN, IN, OH, PA, VA, NC, & MD). Concerns black walnut could suffer severe mortality if WTB were to become established in the Eastern United States led to the implementation of survey and trapping efforts to assess disease distribution and impacts. In locations found to be positive for the disease, quarantines were implemented to restrict its spread. To date, large-scale mortality due to TCD has not occurred the Eastern United States.

In 2020, only two traps were positive for WTB (Figure 26). Traps in both Baltimore County and Baltimore City, Maryland were found to be positive for the beetle. Both traps fall within a previous established quarantined area. Walnut within the area show no signs of the disease.

Additional information on TCD
[Thousand Canker Disease Mapping and Reporting]

White pine needle damage

Figure 27. White pine needle damage. Photo credit: Cameron McIntire, USDA Forest Service.

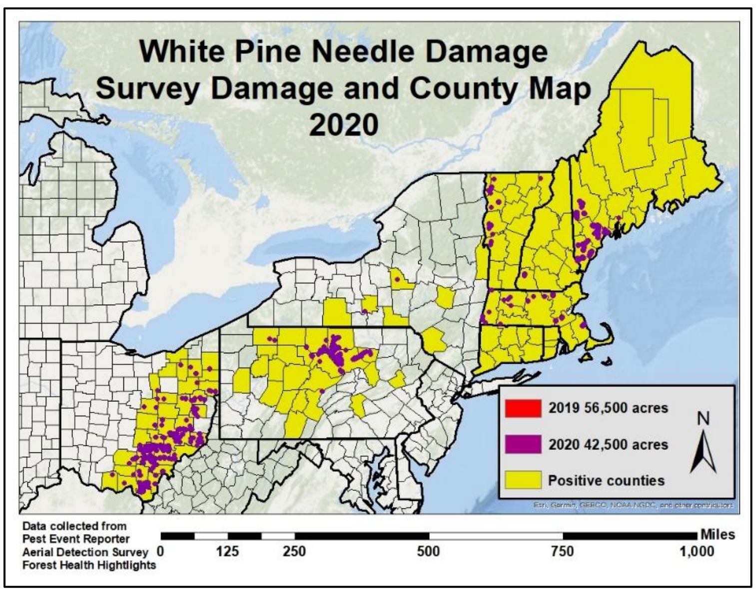

Figure 28. Map of white pine needle damage mapped in 2019 and 2020 and confirmed positive counties for the disease.

Multiple fungal pathogens native to North America are associated with white pine needle damage (WPND) (Figure 27). Brown spot needle blight (*Lecanosticta acicola*) is potentially the primary pathogen contributing to needle defoliation, but needle cast fungi *Lophophacidium dooksii* and *Bifusella linearis*, and a new species *Septorioides strobi* (described in 2016) are also associated with white pine defoliation. Historically brown spot needle blight has been associated more with two and three needled pine, and the needle cast fungi have not typically had such large-scale impacts. *Septorioides strobi* may historically been present without causing the level of damage currently observed.

Optimal environmental conditions for fungal growth and dispersal (warmer winter temperatures and wetter springs) combined with conditions contributing to tree stress (summer drought) are believed to be contributing factors for increasing WPND damage across landscapes. White pine defoliation, reduces growth, and branch and whole tree mortality due to the disease has been observed.

Initially WPND was more prevalent in New England states but environmental conditions conducive to disease development have increased in a number of states like New York and into the Mid-Atlantic region. In 2020, 42,500 acres of damage were recorded during surveys, and was reported in eight states in the Eastern Region (Figure 28). In Maine, premature needle drop from late May through early July has been reported in the southern half of the State, but disease severity between 2019 and 2020 remained relatively consistent. In Vermont, damage

was down from 2019 to 2020 but was still present throughout the State. Roughly 4,700 acres of WPND was recorded in Massachusetts, but crown discoloration, canopy thinning, and general decline was present in all counties. Lastly, WPND has more recently been reported in Ohio, with damage being more severe in the eastern half of the State.

Native pest deviations

Climate change, warming seasonal temperatures, and changes in precipitation (both wetter springs and summer droughts), as well as anthropogenic driven change, such as pesticide use, fire suppression, habitat alteration, etc. are examples of events altering ecosystems and potentially pest behavior. Monitoring of several insects and diseases native to North America have found activity deviating from historical records. Deviation may take the form of range expansion where insects and diseases become established outside their historic range, prolonged and extensive outbreaks surpassing previous reports for pests, or species not known to undergo outbreaks. Additionally, native organisms, who historically had not been recorded as causal agents, have flourished under "new" conditions, and are having sizeable impacts on forested ecosystems. Key examples of native pest deviating in impacts from historic records include, but are not limited to, bur oak blight, larch beetle (*Dendroctonus simplex*), hickory bark beetle (*Scolytus quadrispinosus*), southern pine beetle, oak shothole leafminer, and white pine needle damage. Below are a few examples of key pests and relatively recent changes in behavior.

New native forest pathogens have been identified and described in recent years. Bur oak blight and the fungal pathogen *S. strobi,* associated with WPND, are believed to be native to the United States but have only recently been causing sufficient damage to draw the attention of forest health and resource managers. Increases in impacts due to both of these diseases, including the other fungal pathogens associated with WPND (described above) are believed to be due to warming temperatures and wetter springs, optimal conditions for fungal growth and spread.

Several known native insects have either expanded their range or are having greater impacts than previously recorded. Southern pine beetle, one of the least cold tolerant *Dendroctonus* spp., historically has been relegated to the Southeast, and to a lesser extent, the Southwest inside its range in the United States. Warming temperatures, specifically warmer winters have permitted the beetle to establish in more northern forests. How far SPB may travel if temperatures continue to rise and what impacts the beetle may have on northern forests is an area of concern.

Larch beetle is undergoing the longest sustained outbreak ever recorded for this insect (Figure 29). Nearly half of the larch population in Minnesota have been impacted. Drivers of sustained elevated levels of larch beetle may include larch populations reaching size and density levels optimal to support an extended beetle outbreak and/or warming temperatures resulting in

greater overwinter survival and a potential transition of some populations from a univoltine (one generation a year) to a bivoltine (two generations a year) or even multivoltine (more than two generations a year) life cycle. Abundant available resources combined with increased overwintering survival and a higher number of beetles produced each year, may have triggered and sustained the current outbreak.

Figure 29. Eastern larch killed by larch beetle. Photo credit: Steven Katovich, USDA Forest Service, Bugwood.org.

Changing climates appears to be altering behavior and impacts of native pests. In this section we described only a few, but there are more. If conditions are right for development and range expansion of native insects and diseases, what other forest pests may capitalize on current and future climates? Additionally, changing climates may impact established invasive species such as emerald ash borer, gypsy moth, and oak wilt. Will warming trends alter their impacts on the system? A changing climate requires forest health staff to monitor known insects and diseases as well as be on the lookout for new native organisms waiting to take advantage of more favorable environmental conditions.

Abiotic damage

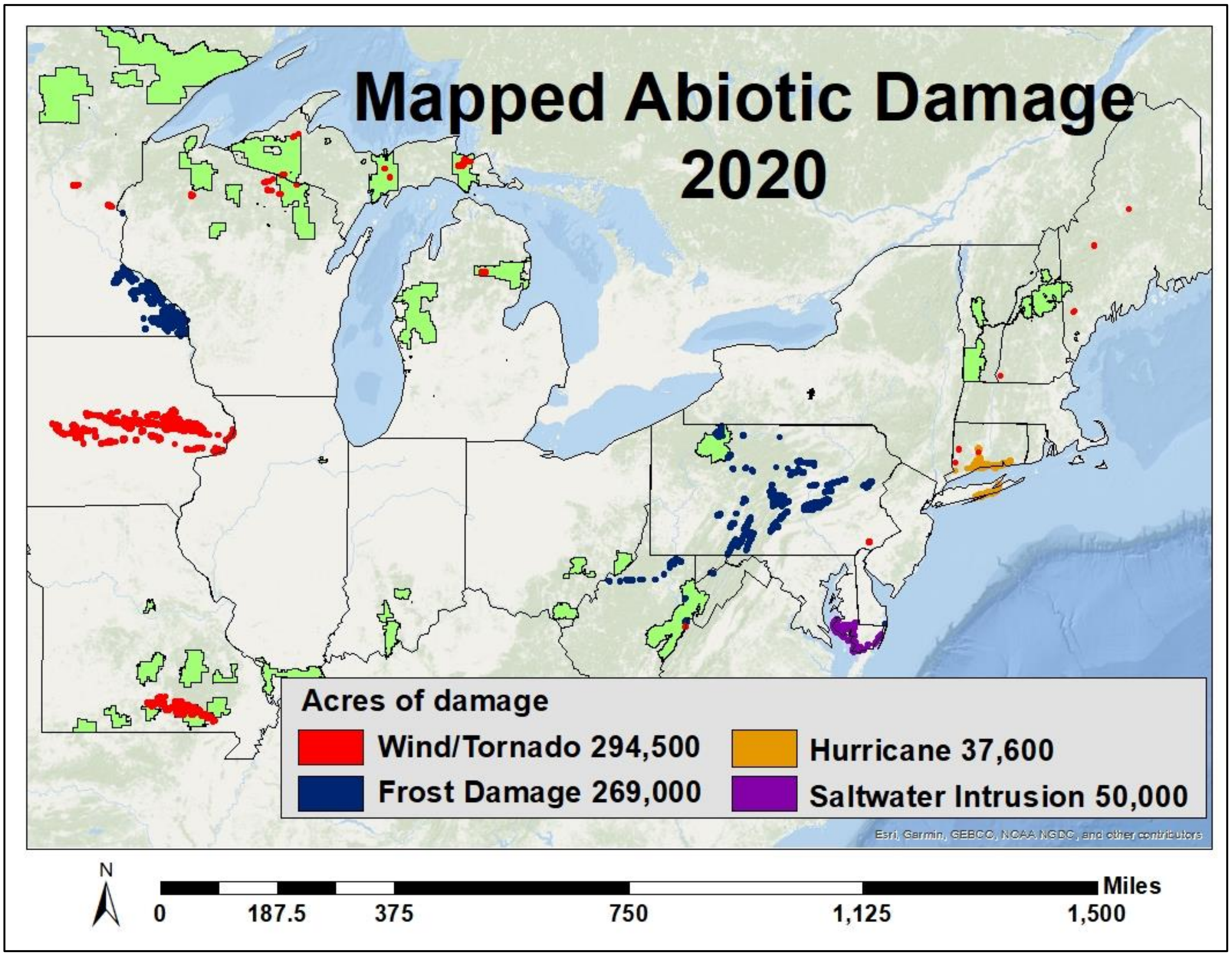

Figure 30. Abiotic damage recorded during surveys in 2020.

Damage caused by several abiotic events impacted Region 9 in 2020. In total, roughly 650,000 acres of abiotic damage were recorded last year. This includes 294,000 acres of wind/tornado damage, 269,000 acres of frost damage, 37,000 acres of damage due to Tropical Storms, and 50,000 acres of saltwater intrusion damage in Maryland (Figure 30). Abiotic damage can lead to increases in insect and disease activities in affected stands. Damaged and stressed trees are more susceptible to colonization and infection by forest insects and diseases. Areas damaged by abiotic events should be monitored for potential additional damage due to forest insects, diseases, and colonization by invasive plants.

Frost damage

Late season frosts in April and May impacted much of Region 9, with damage to oaks being primarily reported. A frost in Missouri in mid-April caused damage in various parts of the State. Damage in Missouri varied by location with injury to expanding leaves and buds, branch dieback and delayed leaf out being reported. In Michigan, trees were impacted when severe frost in May hit across much of the Lower Peninsula, with overnight temperatures for consecutive nights falling to the mid to low 20s. Localized damage was also reported in the Upper Peninsula.

In Minnesota, frost damage, primarily in the southeast portion of the State, was reported to have severely hit low-lying oaks. Widespread frost damage in the central and north central portion of Wisconsin was reported in mid to late May. In Wisconsin, late season frosts have been occurring regularly over the past decade. In Pennsylvania, oak growing on ridge slopes, and beech throughout northcentral portions of the State were affected. Trees in Pennsylvania had deformed leaves, and low seed abundance was reported due to frost impacting flowering of some species. In Delaware, leaf necrosis and chlorosis due to frost was recorded as well as damage to some fruit within the State.

Saltwater intrusion

Saltwater intrusion damage was reported in Maryland on roughly 50,000 acres. Damage was recorded across the lower Eastern Shore. The four southeastern most counties were impacted. Saltwater intrusion damage increased from 10,000 acres in 2019. Maryland reported severe to very severe damage in most of the mapped areas.

Storm damage

On 10 August 2020, a derecho, a widespread fast-moving storm, causing hurricane-force winds, hit the Midwest with a majority of recorded damage mapped in Iowa. Strong winds topping out at 120 miles/hour knocked down and broke limbs of numerous trees across central Iowa and northern Illinois. Iowa Department of Natural Resources reported aerial surveys successfully assessed 90% of the storms area within the State. Based on aerial survey, over 230,000 acres, roughly 8% of Iowa's forested lands, were damaged by the storm's high winds. (Figure 25). Monitoring efforts looking for insect and disease activity, as well as colonization by invasive plants in damaged areas are planned.

In early August, Tropical Storm Isaias hit along the east coast of the United States. Trees and power lines were downed, and more than 3 million power outages were reported. Nearly half of reported outages were in New Jersey. Following Tropical Storm Fay, this was the second tropical storm to impact Northeastern States in a 3-week period. Roughly 37,000 acres of damage were mapped in Connecticut and New York due to the storm. Broken limbs and downed trees were recorded, and damage caused by windblown salt water was recorded up to 50 miles inland in Connecticut. Portions of New York and Connecticut were without power for days following the storm.

Additional forest health issues.

Table 2. Additional forest health issues not included in this report, and the state FHH report(s) where these topics are discussed. ([Region 9 2020 FHH])

Subject	Scientific Name(s)	State FHH Reports
Anthracnose	Multiple spp.	CT, DE, IL, IN, IA, MO, NJ, and PA
Bacterial leaf scorch	*Xylella fastidiosa*	DE, MD, and NJ
Beech bark disease complex	Beech scale insect (*Cryptococcus fagisuga*) and fungi *Neonectria faginata* and *N. ditissima*	CT, DE, and WI
Browntail moth	*Euproctis chrysorrhoea*	ME
Butternut canker	*Ophiognomonia clavigignenti-juglandacearum*	IA
Chestnut oak mortality	Unknown causal agent(s)	IN
Dutch elm disease	Native elm bark beetle (*Hylurgopinus rufipes*) The smaller European elm bark beetle (*Scolytus multistriatus*) The banded elm bark beetle (*Scolytus schevyrewi*) and fungi *Ophiostoma ulmi* and *Ophiostoma novo-ulmi*	DC and IA
Eastern larch beetle	*Dendroctonus simplex*	MI, MN, and WI
Fall webworm	*Hyphantria cunea*	MA, MN, NJ, PA, and VT
Forest tent caterpillar	*Malacosoma disstria*	IA, MN, VT, and WI
Giant Hogweed	*Heracleum mantegazzianum*	MI and NY
Herbicide damage		IL and MO
Heterobasidion root disease	*Heterobasidion irregulare*	IA, MI, and WI
Jackpine budworm	*Choristoneura pinus*	WI
Kudzu	*Pueraria montana*	IN, NY, and RI
Laurel wilt	Redbay ambrosia beetle (*Xyleborus glabratus*) and fungi *Raffaelea lauricola*	IL, IN, and MO
Northern walking stick	*Diapheromera femorata*	PA
Oak decline	Multiple agents	DC, DE, and MD
Rapid white oak mortality	Unknown agent(s)	IA and IL
Red pine shoot moth	*Dioryctria resinosella*	MN
Resistant ash research	*Fraxinus* spp.	MI
Saddled prominent	*Heterocampa guttivitta*	NH and VT
Winter moth	*Operophtera brumata*	CT and ME

New publications by forest health staff

Carta, L. K.; Handoo, Z. A.; Li, S.; Kantor, M.; Bauchan, G.; McCann, D.; Gabriel, C. K.; Yu, Q.; Reed, S.; Koch, J.; Martin, D. and Burke, D.J. (2020). Beech leaf disease symptoms caused by newly recognized nematode subspecies *Litylenchus crenatae mccannii* (Anguinata) described from Fagus grandifolia in North America. For Path. 00:e12580. https://doi.org/10.1111/efp.12580

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Engelken, P. J. and McCullough, D. G. (2020). Riparian forest conditions along three northern Michigan rivers following emerald ash borer invasion. Canadian Journal of Forest Research, 50(8), 800-810.

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Juzwik, J.; Haugen, L.; Schneeberger, N. F.; Rawinski, T. J.; Rothlisberger, J. D.; Poland, T. M. (2021). Regional Summaries: Northeast Region. 2021. In: Poland, T. M.; Patel-Weynand, T.; Finch, D. M.; Ford Miniat, C.; Hayes, D. C.; Lopez, V. M., eds. Invasive species in forests and rangelands of the United States: A comprehensive science synthesis for the United States forest sector. Heidelberg, Germany: Springer International Publishing: 420 - 425. Appendix.

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Forest health staff directory

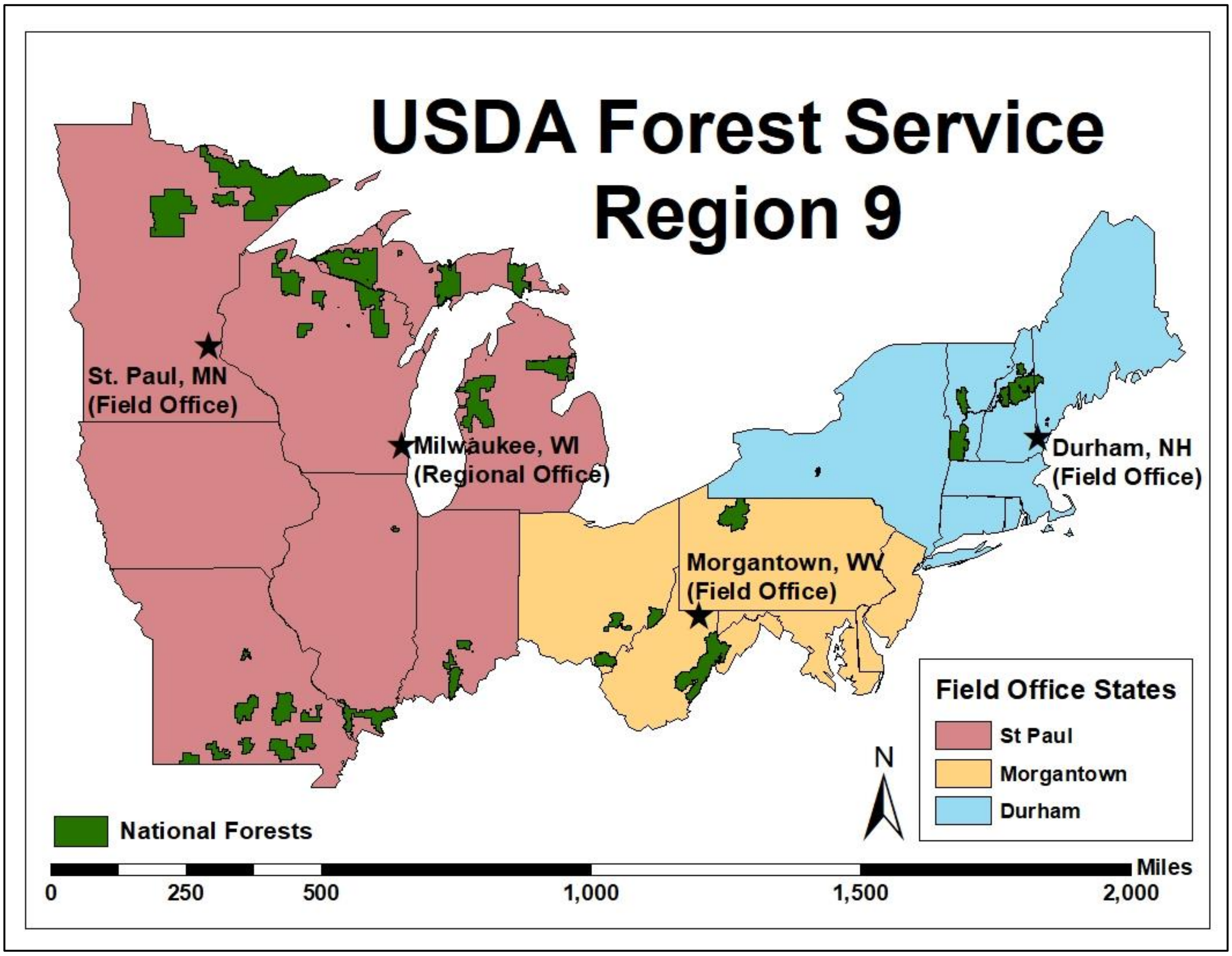

Figure 31. Region 9 states, regional office location, and field offices and the states they service.

Regional office

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